Curriculum Vitae: Kevin R. Vixie

Contact Information:

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Education

Ph.D. 12/2001 Mathematics (Systems Science Program), Portland State University, Advisor: Andrew M. Fraser Dissertation Title: "Signals and Hidden Information".

Employment (recent history)

Research Scientist New Mexico Consortium, 1/2008 – present

Member of Technical Staff Los Alamos National Laboratory, 11/2001 – present

Adjunct Associate Professor Clarkson University, Potsdam NY 1/2004 – present

Graduate Research Assistant Los Alamos National Laboratory, 3/1998 – 11/2001

Graduate Research Assistant Portland State University, 1/1996 – 3/1998

Senior Research Associate Oregon Health Science University, 6/1992 – 12/1995

Research Interests:

1) Geometric Analysis (defined rather broadly to be geometric measure theory with pieces of harmonic and variational analysis as well as PDEs and hard analysis.), 2) geometry in high and infinite dimensions (e.g. concentration of measure, random projections), and 3) prototyping algorithms implementing ideas from 1) and 2) for data (especially image) analysis challenges.

Publications-I (accepted or published, including reports)

1. *The generalization of Mathematical Description* (KRV), Proceedings of the 1997 International Institute for General Systems Studies, San Marcos, Texas. (.pdf) (.ps)

2. *Persistence and Recurrence in Atmospheric Circulation*, (Andrew M. Fraser, Richard Smith, KRV and Padhraic Smyth), conference paper at Interface97 held in Houston, Texas May 14-17, 1997. (.ps)

3. *The Bispectral Aliasing Test: A Clarification and Some Key Examples*, (KRV, Murray Wolinsky, and David Sigeti). Conference paper at the *International Symposium on Signal Processing and its Applications* August 22-25, 1999, Brisbane, Australia (.pdf)

4. *Signals and Hidden Information* (KRV) Ph.D. Dissertation, 2001 (.pdf) (.ps)

5. *Standard 2D Test Objects for Radiographic Inversion Studies* (T. Asaki and KRV), 2002 LA-UR-02-3978 (.pdf)

6. *SVD Analysis for Radiographic Object Reconstruction I: Initial Results*, (Thomas J. Asaki and KRV) 2002 LA-UR-01-6534 (.pdf)

7   *SVD Analysis for Radiographic Object Reconstruction II: Null Space Enhancements*, (T. Asaki and KRV), 2002 LA-UR-03-5937 (.pdf)

8   *Incorporating invariants in Mahalanobis distance based classifiers: Application to Face Recognition*(Andrew M Fraser, Nicolas Hengartner, KRV and Brendt E. Wohlberg) Proceedings of the IJCNN Portland, Oregon, July 2003 (.pdf) (.ps)

9   *Classification modulo invariance, with application to face recognition* (Andrew M Fraser, Nicolas Hengartner, KRV and Brendt E. Wohlberg), Journal of Computational and Graphical Statistics, v 12, p. 829-852, December 2003. (.pdf)

10 *SVD Analysis for Radiographic Object Reconstruction III: Total variation regularization*, (Thomas J. Asaki and KRV) 2004 LA-UR-04-7076

11 *Variational Analysis, PDEs and Image Analysis: the big picture and a sampling of details* (Nathan D. George and KRV) Proceedings of "Contemporary Problems in Mathematical Physics", December 2004 (.ps)

12 *Information extraction from muon radiography data*, (K. Borozdin, T. Asaki, R. Chartrand, N. Hengartner, G. Hogan, C. Morris, W. Priedhorsky, R. Schirato, L. Schultz, M. Sottile, KRV, B. Wohlberg and G. Blanpied) in ISAS/CITSA 2004: International Conference on Cybernetics and Information Technologies, Systems and Applications and 10th International Conference on Information Systems Analysis and Synthesis, Vol 2, Proceedings : Communications, Information and Control Systems, Technologies and Applications, pp. 27–30, 2004 (.pdf)

13 *Nonlinear regularizations of TV based PDEs for image processing* (Andrea Bertozzi, John Greer, Stanley Osher and KRV), in "Nonlinear Partial Differential Equations and Related Analysis", Contemporary Mathematics vol. 371, p.29-40, March 2005, LAUR-04-8435 (.pdf)

14 *Abel inversion using total-variation regularization*, (T. J. Asaki, R. Chartrand, KRV and B. Wohlberg) , Inverse Problems, no. 21, pp. 1895-1903, 2005 (.pdf)

15 *Defensible metrics and merit functions* (KRV and Thomas J. Asaki), 2005 LA-UR-04-8498. (.pdf)

16 *Abel inversion using total-variation regularization: Applications* (Thomas J. Asaki, Patrick R. Campbell, Rick Chartrand, Collin E. Powell, KRV and Brendt E. Wohlberg), Inverse Problems in Science and Engineering, V14, n8, December 2006, 873-885 (.pdf)

17 *Invariant Template Matching with Tangent Vectors* (Brendt E. Wohlberg and KRV) "Optical Engineering", March 2007, **46**(3) 037006, (.pdf)

18 *Sparse Radiographic Tomography and System Identification Imaging from Single View, Multiple Time Sample Density Plots* (Thomas J. Asaki, Erik M. Bollt and KRV), Computational Methods in Applied Mathematics, V6, n4, 2006 p. 354-366 (.pdf)

19 *Algorithm for Model Validation: Theory and applications* (D. Sornette, A.B. Davis, K. Ide, KRV, V. Pisarenko, and J.R. Kamm), PNAS 2007 104(16): 6562-6567 (.pdf)

20 *Existence and non-uniqueness for $\int |\nabla u|^{p(|\nabla u|)}$ regularized image functionals* (Pete Schultz, Erik M. Bollt, Rick Chartrand, Selim Esedoglu and KRV), accepted

21 *$L^1 TV$ computes the flat norm for boundaries* (Simon P. Morgan and KRV), Abstract and Applied Analysis, Volume 2007 (2007), Article ID 45153, 14 pages preprint (link)

22 *Review of "Deblurring Images: Matrices, Spectra and Filtering"* (KRV) SIAM Review, December 2007 Vol 49 No. 4 pp. 722-725

Publications-II (in submission or preprints)

1 *Image Denoising by Regularization on Characteristic Graphs*(Thomas J. Asaki, Pavlo Cherepanov, Matthew Sottile and KRV) Submitted 2007

2 *Some properties of minimizers for the Chan-Esedoglu L1TV functional.* (KRV), preprint (.pdf)

3 *Detection of aliasing in deterministic signals* (KRV, David E. Sigeti and Murray Wolinsky), submitted (.pdf) (.ps)

4 *A gradient descent solution to the Monge-Kantorovich problem* (Rick Chartrand, KRV, Brendt E. Wohlberg, and Erik M. Bollt) preprint (.pdf)

Publications-III (notes, various levels of roughness)

1 Notes from fall 1998 nonlinear control theory prep (Notes.pdf) (Notes.ps)

2 Introductory notes I wrote for the 2002 Image analysis workshop (Notes.pdf)

3 Slides from my IPAM graduate Summer school short course. (slides.pdf)

4 Notes from my GMT lectures at UCLA/IPAM spring of 2007. See the links at the end of the 2007 Data Sciences Summer School GMT course expanded bibliography page for pdf's of the notes. They are hand written, in color with lots of figures.

Talks (links to slides for some)

1 IIGSS Meeting San Marcos Texas, 1997

2 AMS/MAA New Orleans, January 2001

3 Snowbird, SIAM Dynamical Systems, May 2001

4 Snowbird, SIAM Dynamical Systems, May 2001

5 2 talks, Boston, SIAM Imaging Science, March 2002

6 2+ talks, LANL Radiography workshop, Aug 2002 (vixie .pdf) (asaki .pdf)

7 LANL Image Analysis Workshop December 2002 (.pdf)

8 National Academy of Sciences workshop on Massive Data Streams, December 13, 2002

9 Duke University, January 2003

10 IJCNN 2003, Portland, Oregon, July 20-24, 2003

11 Clarkson University, September 2003

12 LACSI, Santa Fe NM October 2003

13 LANL, Kamm LDRD-DR review June 2004

14 Clarkson University, September 2004 (.pdf) (.ps) (.supplement)

15 Banff International Research Station, Banff, Alberta October 2004 (.pdf)

16 ISR Division, December 2004 (.pdf) (.ps)

17 UMinn/IMA, December 2004

18 AMS/MAA, Atlanta January 2005 (.pdf)

19 Short Course (3 lectures), IPAM Graduate Summer School 2005, (.pdf) (video)

20 AMS Meeting Bard College, October 2005 (.pdf)

21 Short Course (5 lectures), Clarkson University, January 2006 (.pdf days 1-3) (.pdf days 4-5)

22 EP Differentials Shape Retreat, Santa Fe, July 2006 (Link)

23 Colorado State University Workshop, Sept 2006 (Link) – 2 talks
DDMA Overview Lecture .pdf
Geometric Analysis Lecture .pdf

24 DDMA Lecture Series Short Course, Sept 2006 (.pdf lectures 1-3) (.pdf lectures 4-5)

25 DDMA Geometric Analysis Lectures. Continuing lecture series on geometric analysis. October 2006 – present.

26 Course in "Geometric Measure Theory", UCLA/IPAM/LANL, spring 2007, (website)

27 Lecture, Stan Osher's Level Set Seminar series, 4/24/2007, "Questions and Answers in Geometric Measure Theory for data Analysis" (white Board talk)

28 IPAM, Random Shapes Program, Spring 2007, Lecture in "Workshop IV: Image Processing for Random Shapes: Applications to Brain Mapping, Geophysics and Astrophysics" (slides, audio stream)

29 Designed and co-taught a course "Geometric Measure theory", CDDMA summer school, Summer 2007, (website)

30 Invited Seminar, Clarkson University, January 2008

Conferences and Workshops:

- **2001 SIAM Dynamical Systems Conference at Snowbird:** Organized 2 Special Sessions on Hidden Markov Models and their applications.

- **2002 SIAM Imaging Sciences conference in Boston:** Organized 3 Special Sessions on Dynamics and Radiography.

- **2002 LANL Radiography Analysis and Simulation Tools Workshop:** On organizing committee.

- **2002 LANL Image Analysis Workshop:** Organizer of the 2002 workshop on Image Analysis at LANL

- **IPAM RIPS Program:** Our team has been sponsoring a RIPS team since summer 2003. This will be our 4th summer.

- **2005 IPAM Graduate Summer School:** Organizing Chair and short course lecturer. "Intelligent Extraction of Information from Graphs and High Dimensional Data". July 11-29, 2005.

Data Driven Modelling and Analysis (DDMA) team :

- With Tom Asaki, I Founded the team early 2002. Team now has about 25 members at LANL and external institutions including Rice, UCLA, Duke, U Michigan, Montana State, U Minnesota and Clarkson.

- Initiated the DDMA workshops, in which we converge on some central location and generate prototype algorithms to solve a wide range of problems for diverse customers. Early 2005.

- Established the DDMA visiting speaker series, winter 2005 (link)

- Established the lead team, summer 2005.

- Currently: I help lead the team, continue to raise or help raise a large fraction of the 3M\$/year budget, and am helping lead the theoretical end of our data analysis efforts.

Funding From Grants and Contracts:

150K\$ PI on a LANL LDRD-ER grant, 2001 150K\$ for work on face recognition.

500K\$ co-PI on a LANL LDRD-DR grant, 10/2002 – 9/2005 1.3M\$/year. The focus of this research is the use of rigorous methods for incorporating physics into the Validation and

Verification of simulations. Our team's part of the money was about 500K\$ in total. Jim Kamm was the PI.

1.1M\$ PI on a LANL LDRD-ER grant 10/2003 – 9/2006   360K\$/year for work on data analysis methods which factor out invariances for the purpose of recognition.

600K\$ co-PI on a LANL LDRD-DR grant 10/2003 – 9/2006 1.3M\$/year. The research was focused on developing muon radiography as a viable method of intra-diction of SNM at borders. The part our team is working on has to do with the data analysis end of things, in particular image reconstruction. Our part of the money will amount to about 550K\$ in total. Konstantin Borozdin is the PI.

400K\$ co-PI on a 200K\$ grant from the NSF Approaches to Combat Terrorism (ACT) program, for "Intelligent Extraction of Information from Graphs and High-Dimensional Data", the 2005 Graduate Summer School I Chaired. I raised another 200K\$ from the LANL Chief Science Officer for the summer school.

1.1M\$ PI on "Metrics and Regularizations for Data Analysis", a winning 2005 LANL ASC WSR grant 380K\$/year for 3 years. The work is focused on development of new image metrics.

200K\$ NGA Contract for research. About 200K\$.

950K\$ PI on an LDRD-ER proposal, "Sharp characterization of minimizers (typically) involving interfaces in images". Roughly 315K\$/year for FY 2006-2008. Co-PIs are Bill Allard (Duke) and Selim Esedoglu (Michigan). Note: the proposal references a rough draft of *Some properties of minimizers for the L1TV functional* now submitted (.pdf). (Proposal .pdf) (Cover page .pdf)

305K\$ Co-PI (Selim Esedoglu PI) NGA Hyperspectral Image Processing Contract, 2007-2008.

250K\$ Co-PI with Rick Chartrand. NGA Contract for research.

Notes: Due to high LANL overhead, X\$ (LDRD) are equivalent to about 0.7*X\$ at a University. Due to a separate, even higher overhead, X\$ (LANL programmatic) is equivalent to about 0.5*X\$ at a university. The WSR funds and the NGA funds fall into this second "less valuable" category. The average success rate for LDRD proposals is about 10%.

Student Mentoring

Student	Time Period	Currently at
Gary Sandine (GRA)	1999-2002	TSM in T-7 at LANL
Zeferino Andrade (GRA)	2002 summer	?
Neal Martin (UGS)	2002-2003	U. Pittsburgh, Econ. Ph.D. prgm
John Greer (GRA)	2003 summer	Courant, NSF Postdoc
Triet Le (GRA)	2003-2004 summers	UCLA (soon: NSF Postdoc at Yale)
Andrea Hawkins (UGS)	2004 summer	UT Austin, Mathematics
Nathan George (GRA)	2004-2005	UC Berkeley, Ph.D. Prgm
Patrick Barrow (GRA)	2005 summer	UC Berkeley. Ph.D. Prgm
Joe Kenney (GRA)	2005 summer	U Minn, Ph.D. Program
John Sieffert (GRA)	2005 summer	U Miss – Rolla, EE PhD Prgm
Valentina Staneva (UGS)	2005 sum, 2006 sprng	LANL (under R. Chartrand)
Patrick Campbell (UGS)	2002-2007	U Minn, PhD Prgm.
William Meyerson (GRA)	2007 summer	UCLA
David Bolme (GRA)	2007 summer	Colorado State University
Abhishek Bhattacharya (GRA)	2007 summer	University of Arizona
Djamila Auoada (GRA)	2007 summer	North Carolina State University
Kree Cole-McLaughlin (GRA)	2007 summer - present	UCLA

Postdoc Mentoring

Postdoc	Time Period	Comments
Zhijun Qiao	2004	(now at University of Texas-Pan Am)
Rick Chartrand	2004-2005	(now LANL Technical Staff Member)
Chris Orum	2004-2007	(co-Mentored with Nick Hengartner)
Bryan Rasmussen	2006-2007	(Co-Mentored with Katharine Chartrand)
David Dreisigmeyer	2006-present	(Co-Mentored with other DDMA members)
Simon Morgan	2007- present	

Teaching Experience

- 7th and 8th grade science and history (1 year).
- Extensive tutoring experience: Engineering, Mathematics, Physics.
- *Undergraduate Courses in Mathematics* Significant experience as full instructor for: a) Pre-calculus, b) Business Calculus, c) Calculus (all semesters), and d) Differential equations.
- *Pontrjagin Maximum Principle* fall 1998 at LANL. I gave lectures preparing a handful of staff members the nonlinear control theory short course at the 1999 AMS/MAA meetings in San Antonio.
- *Modern Analysis*: A course designed and taught with Gary Sandine at Los Alamos National Laboratory. Students were at or above the graduate student level. Course was very fast-paced, with 75 students covering topology for analysis, calculus in Banach spaces, and some nonlinear analysis. Spring 2000.
- *Dynamical Systems*: I helped teach this course as a follow-on to the Modern Analysis course above. Same type of audience. I gave several lectures. Summer 2000.
- 3 hour short course, *Metrics and Regularizations in Image Analysis* at the IPAM 2005 summer school. See links to slides and video above.

- 5 hour short course, *An Invitation to Geometry: Image Analysis, Geometric Analysis, and High-dimensional Geometry* Clarkson University, January 2006. See links above.
- 5 lecture short course, *An Invitation to Geometry: Image Analysis, Geometric Analysis, and High-dimensional Geometry*, Los Alamos National Laboratory, September 2006. See links above.
- Lecture series at the graduate level at LANL on various topics in geometric analysis. Fall 2006 to present.
- 8 lecture course, *Geometric Measure Theory* at UCLA/IPAM with Video link to LANL, Spring 2007
- 16 lecture course, *Geometric Measure Theory* at the CDDMA 2007 summer school. I designed it and co-taught it with Simon P. Morgan and Peter F. Schultz.

Other Experience and Activities

- Started the Proton Radiography Working group at LANL and ran it for 3 years. Part of this is now folded into the DDMA team, the rest which I handed off to others quietly died.
- Started the LANL Student Association Colloquium Series and ran this for 1.5 years. After I quit running it, it also ceased to exist (as did several other aspects of the Student association, when official lab entities got more involved).
- For more history and the meandering path taken to the present, see the *Acknowledgements* in the preamble of my dissertation (.pdf) (.ps)

References :

William K. Allard	Mathematics Department
	Duke University, Box 90320
	Durham, NC 27708-032
Selim Esedoglu	Mathematics Department
	University of Michigan
	2074 East Hall, 530 Church Street
	Ann Arbor, MI 48109
James M. Hyman	Los Alamos National Laboratory
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	Los Alamos, New Mexico 87545
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	Los Angeles, CA 90095-1555
Donald C. Wunsch	Department of Electrical and Computer Engineering
	University of Missouri - Rolla
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